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in Australia)

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CALIFORNIA EXPERIENCE WITH EUCALYPTUS

By J. W. Duffield

Institute of Forest Genetics
California Forest and Range Experiment Station

Contents

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INTRODUCTION

In view of the short time available for the preparation of this report and the fact that California has been by far the most active state in the United States in the introduction and exploitation of *Eucalyptus*, the writer has taken the liberty of limiting this report largely to California's experience. It may be noted that *Eucalyptus* has been introduced into parts of Arizona, New Mexico, Texas and Florida. In 1911, a report on *Eucalyptus* in Florida (9) recorded the introduction of this genus in Florida as having taken place in 1878, about 20 years later than the first introductions into California. This report noted also that some of the early Florida introductions were made by Californians. In view of the differences between the climates of these two states, it is not surprising that some of the species found promising in California proved to be of slight value in Florida.

Land areas, Forests, afforestation history and possibilities in California.

Many of the data which follow are abstracted from a 1946 Forest Survey Release (8).

1/ The Experiment Station is maintained by the Forest Service, U. S. Department of Agriculture, in cooperation with the University of California, Berkeley.

Land areas in California are as follows:

Major vegetation type	Area Million Hectares	Million Acres	Percent
Timber forest	7.3	18	18
Other conifer forest	2.4	6	6
Woodland (angiosperm trees)	4.0	10	10
Chaparral	4.0	10	10
Sagebrush (<u>Artemisia</u>)	2.8	7	7
Grass	4.0	10	10
Desert	9.7	24	24
Cultivated, urban and industrial	5.7	14	14
Barren	0.4	1	1
Total land area of California	40.3*	100	100

Timber cropland, a category which "includes all areas, regardless of present cover, that appear to possess the climate and soil qualities essential for the production of commercial timber crops," (8) totals 6.9 million hectares (17.1 million acres). Of this area, 5.3 million hectares (13 million acres) are available for production and exploitation of commercial forest.

The area of successful forest plantations in California (excluding <u>Eucalyptus</u> plantations) is so small as to be insignificant in relation to the area of timber cropland so poorly stocked as to require reforestation and interplanting. "The total very poorly stocked (up to 20 percent of ground covered with timber growth) and unstocked timber cropland which is so located as to be considered suitable for economic operation within the next 30 to 40 years (1) is 1.7 hectares (4 million acres). This area includes lands of all site qualities. Within this area, 0.36 million hectares (0.95 million acres) are classified as being of high site quality, and of this latter area, 52 percent is covered with chaparral (1).

These figures on forest land area and potential land area available for afforestation, or, more accurately, reforestation, are not strictly relevant to the potentialities of <u>Eucalyptus</u> culture in California. The

bases for this statement are both biological and economic. Much of the land available for forest planting in California is located in climates too cold for most _Eucalyptus_ species. Other lands, with climate suitable for _Eucalyptus_ culture, will probably find their highest use in agriculture. Because California must support a large industrial population within her borders, and can expect a continued market for her agricultural products outside of her borders, timber production is likely to be consigned to the higher elevations and colder regions of the state, where _Eucalyptus_ culture is unlikely to be practicable.

It has been estimated (6) that approximately 20,000 hectares (50,000 acres) of _Eucalyptus_ plantations have been set out in California. At present, the area of _Eucalyptus_ plantations is considerably smaller as a consequence of the removal of many groves from irrigable lands more valuable for agriculture. The four principal species in plantations were listed as follows in 1924 (5):

Species	Percentage of plantation area
Eucalyptus _globulus_ Labill.	80
" _tereticornis_ Smith and _E. rostrata_ Schlecht.	15
" _corynocalyx_ F.v.Mueller	4
Others cladocalyx	1

Since 1924, the relative areas devoted to species have not changed appreciably.

The environmental factors in relation to Eucalyptus culture in California.

A. Climate

A recent study (3) of _Eucalyptus_ in California presents generalized maps showing the distribution of plantings in 1925 and 1951. In 1925,

the general area in which plantings occurred corresponded rather closely to that area in which the minimum temperature of record was -10° C. (15° F.) or higher (see map in Appendix). Little change in the general area of distribution of Eucalyptus plantings had occurred by 1951. Therefore, for the purposes of this report, those areas of California for which temperatures below -10° C. have been recorded will be omitted from consideration. This leaves the whole Pacific Coastal area of California, extending to a depth of approximately 20 kilometers in the north to about 50 Kilometers in the south. In addition, much of the central valley of California, drained in the north by the Sacramento River and to the south by the San Joaquin River, is included. Thirdly, an area along the lower Colorado river in southeastern California is included. Much of this third area in which minimum temperatures permit Eucalyptus culture is otherwise unsuitable because the mean maximum temperature of July, the hottest month, exceeds 40° C. and the average annual precipitation is less than 13 centimeters. Here, Eucalyptus can be grown only where its value for windbreaks justifies the cost of the necessary irrigation. Detailed climatic data and some information on relative frost hardiness of Eucalyptus species are given in the appendix.

B. Topography

The temperature relations just outlined are related rather closely to topography. Eucalyptus is seldom found at elevations exceeding 300 meters in California. This, however, does not mean that Eucalyptus may be grown generally below this elevation.

C. Soils

Eucalyptus globulus, the most commonly planted species, grows well on the clay loam to adobe soils of the north coast region (5). It is less

cladocalyx

successful, particularly as regards form and growth rate, on excessively sandy or highly alkaline soils. *E. rostrata* is the most tolerant of flooding of the commonly employed species, while *E. corynocalyx* cladocalyx is the least tolerant of excessive soil moisture. The effect of salts in the soil solution has been studied extensively by Loughridge (4) who found *Eucalyptus* species to be intolerant of carbonates but rather tolerant of sulfates and chlorides. In general, California experience has been that *Eucalyptus* species are not markedly less exacting in their soil requirements than other trees climatically adapted. Indeed, Metcalf has pointed out that land which has been classified as of site quality I on the basis of yields of *E. globulus* is being converted to agricultural use.

Culture data STOP

The propagation, planting and plantation care of *Eucalyptus* present no unusual problems.

In California, seed has, for many years, been secured from California-grown trees. Little is known of provenience, although this may be a matter of great importance if *Eucalyptus* is to play a more significant role in California's economy. Two questions of provenience have been raised, and their further study may possibly be rewarding. The first concerns the possible differences between *E. globulus* of Tasmanian origin on the one hand and Victorian or New South Wales origin on the other. It has been suggested by Metcalf (5) and others that the "San Jose Blue Gum", which was a reasonably satisfactory lumber producer, unlike *E. globulus* grown elsewhere in California, was of Victorian origin while the majority of the groves of this species in California originated from Tasmanian seed. These races may possibly be recognized by capsule size. The Australian mainland races are supposed to have smaller capsules and more scaly bark than those

of Tasmania. The second provenience problem may indeed be of a taxonomic or nomenclatorial nature. It concerns _E. regnans_, F.v.Mueller, an entity which numerous visitors to Australia have warmly endorsed for trial in California. This entity is supposed to occur in New South Wales, Victoria, and Tasmania. The synonymy includes _E. amygdalina_ var. _regnans_ and _E. fastigiata_ Deane and Maiden. Some trees known as _E. regnans_ have been rather disappointing, particularly as regards cold resistance (5) in California plantations.

The major problem encountered in seed collection is to secure sufficient unopened capsules from tall trees. Seed extraction presents no special problems, open air drying of capsules often being satisfactory. Little has been written concerning seed storage, particularly long-time storage.

Since _Eucalyptus_ seeds are rather small, they must not be sown too deeply. Hence watering in seed beds or flats must be carefully done to avoid washing. Damping-off is somewhat of a problem. Ingham (2) has included _E. globulus_ in a brief list of the species most susceptible to damping-off. Half-shade in the nursery is advisable.

One-year seedlings appear to be the most satisfactory for planting, and should not exceed 10 inches in height for most efficient handling. Both bare-rooted and balled plants have been planted successfully. Common practice in California is to grow seedlings in waste tin cans measuring 17 cm. in diameter and 19 cm. in height, or containing approximately 3.8 liters (1 gallon), and to carry these to the planting site, where the tin can is cut away from the enclosed soil ball before planting.

Spacing in plantations of _E. globulus_ should not be closer than 2.3 by 2.3 meters (7.5 x 7.5 feet) optimum yield (Metcalf, 1924) or at a planting rate of 1900 per hectare. (775 per acre). Irrigation and cultivation are advisable during the first year.

Stand treatments depend on the purposes for which the plantations are made.

To date, no important pathological or insect problems have been encountered in the growing of *Eucalyptus* in California. In 1951, according to Professor Metcalf, there was a report of mosaic-like symptoms on trees in Orange County in Southern California, but, in the opinion of some pathologists, this condition may have been a consequence of drought.

Growth and yield of Eucalyptus species

A thorough study of the growth rates of four species of *Eucalyptus* growing in California plantations was made by Metcalf in 1924.

Metcalf's (5) growth study findings may be summarized as follows:

Species	No. of Plantations	Mean Age Years	Mean Annual Height Growth Meters	Mean Annual Volume Growth Cubic Meters Per Hectare
E. globulus	67	10.5	1.48	19
E. rostrata	26	9	1.08	7
E. tereticornis	20	8.1	1.08	6
E. corynocalyx	17	10	1.07	8

Metcalf also gives the height and diameter of a number of species growing in mixed stands at Santa Monica, in Southern California, as follows:

Height and diameter at 27 years of age

Species	Height meters	Diameter in cm. at 1.3 m.
E. globulus	21	75
E. sideroxylon rosea	14	49
E. piperita	16	49
E. tereticornis	29	45
E. diversicolor	30	45
E. viminalis	16	43
E. cornuta	14	42
E. gomphocephala	21	37
E. rostrata	21	37
E. corynocalyx	23	35
E. siderophloia	20	29

Metcalf's only detailed yield study was made on *E. globulus*. His yield table, for which site quality determinations were based on age-height curves prepared from enough of the tallest trees to make 10 percent of the number measured in each grove, is given below:

Yield of Eucalyptus globulus in California
(converted from Metcalf's table)

Age years	Volume in cubic meters, including bark, per hectare Site I	Site II	Site III
2	21	7	0
4	73	42	17
6	150	94	52
8	313	168	98
10	428	238	142
12	521	303	179
14	598	360	202
16	671	412	227
18	733	454	243
20	801	496	265

Utilization of Eucalyptus

Eucalyptus utilization has undergone a complete change in California since the first groves were ready for harvest. In the early days of *Eucalyptus* culture and during the promotional campaigns which resulted in the planting of thousands of acres, the chief stress was laid on the value of these trees as producers of hardwood lumber. Cutting of hardwood timber in the eastern and southern United States was proceeding at a rapid rate, and it seemed that the supply in these regions might soon become seriously depleted. *E. globulus*, as has been noted, was the species most widely planted, and because land of good fertility was then more abundant than later, many of the early groves were planted on sites of high quality. Growth and yield were high, and the form of the trees was good.

It was soon found that Eucalyptus timber was more expensive to mill than that of many other genera, principally because of the high percentage of degrade resulting from warping, twisting and checking of the sawn lumber. Mr. T. J. Gillespie of San Jose was more successful than other manufacturers in producing lumber of high quality. This has been attributed to two factors: he was, in general, utilizing older trees and these were thought to be of Victorian origin, while the bulk of E. globulus being sawn was Tasmanian origin. Despite careful kiln drying experiments conducted by H. D. Tiemann of the U. S. Forest Products Laboratory, no satisfactory means of seasoning and relieving growth stresses of E. globulus timber were found.

E. globulus does not enjoy a good reputation as a lumber producer in Australia. Its widespread planting in California appears to have been ill-advised, at least as a means to produce lumber. Attention was, therefore, diverted to other uses of this rapid-growing, well-formed tree. For a time, several mills were successful in manufacturing insulator pins for telephone and telegraph lines from E. globulus, but this was soon eliminated as a result of competition with other species grown in other regions.

Marine pilings of Eucalyptus have not proven superior to treated Douglas fir, and are at least as costly. E. globulus has been used successfully for buffer strips above the water line in piers and for other uses about harbors where the chief demand is resistance to friction and shock.

Eucalyptus fence posts have been only partly satisfactory. Posts cut from small stems are easily peeled, but must be treated since they consist largely of sapwood which will last only 2 to 3 years in the ground. Such posts, where seasoned and treated may last for 8 to 10 years (5). Split

posts consisting largely of heartwood are difficult to treat. Untreated split posts of *E. tereticornis* and *E. rostrata* are moderately durable. *E. globulus* heartwood does not last long in the ground. It is generally difficult to drive staples or nails into *Eucalyptus* fence posts, regardless of type or species. For all these reasons, *Eucalyptus* posts are used only locally and in small numbers.

Some use is at present being made of *E. globulus* for pulp which is used in the manufacture of asphalted and mineral-coated roofing papers. The future of this use is uncertain in view of the increasing use for the same purpose of mill waste from the softwood lumber manufacturing industry of California.

Consumption of *Eucalyptus* wood as fuel remains a rather large use, although a declining one. Reliable statistics are difficult to obtain, but general trends may be noted. Today, California is so well supplied with fossil fuels such as piped and bottled natural gas and various types of petroleum fuel oils, as well as with relatively inexpensive hydroelectric power, that even in logging camps, wood is seldom used for fuel. Obviously this has not always been the case, and at the beginning of the century, *Eucalyptus* fuel wood was important in the economy of the cities and farms of the coast and valley regions. At present, fuel wood is somewhat of a luxury item in the cities and on the farms. Because, most of California's cities are situated in the *Eucalyptus* growing regions, this genus furnishes much of the fuel burned in the fireplaces of city homes. *Eucalyptus* woods give off pleasant odors as they burn, an added incentive to use them. The fuel value per unit weight of *E. globulus* has been reckoned as 93 percent of that of soft coal (5). It would be a mistake, however, to regard the

growing of Eucalyptus for fuel as a promising enterprise for the future. Much of the present consumption is supplied by trees removed for new construction of homes and business structures. An appreciable volume is furnished also by the removal of large trees from the vicinity of existing buildings for the sake of security or opening up views. Eucalyptus, particularly E. globulus is difficult to split, and the difficulty increases as the wood dries. Hence, a grove grown deliberately for fuel production should be harvested before the trees exceed diameters which can be handled and burned without an undue amount of splitting. This generally means a rotation of 10 to 15 years. Since coppice silviculture is well suited both to Eucalyptus species and to fuel production, regeneration furnishes no problems. Few, if any, new groves for fuel production have been established in recent years, and many have been removed for agriculture or construction of homes, highways and industrial plants.

Perhaps the most appropriate and successful use of Eucalyptus in California has been for windbreaks. In Southern California, there are about 2,000 miles of Eucalyptus windbreaks in the citrus growing districts (5). Their value in increasing the value of the crops they protect has been clearly demonstrated, and the windbreak trees are often as carefully tended as the fruit trees. E. globulus is favored because of its dense foliage and rapid height growth, except in the hot interior valleys where E. rudis is better adapted. For most effective use, windbreak trees must be root-pruned, and their crowns should be kept narrow by branch pruning. Many crops other than citrus are protected by Eucalyptus windbreaks, particularly in Southern California.

Pharmaceutical uses of Eucalyptus have been well-known for many years. Distilling of oil from leaves has been practiced sporadically in California

for many years, but at present their is no commercial production of Eucalyptus oil in the United States. Cineol is the valuable constituent of Eucalyptus leaf oil, and the cineol content of California's principal species, E. globulus is not sufficiently high to meet U. S. Pharmacopoeia standards without redistillation. Therefore, it has been impossible for California's oil producers to meet the competition of Australian exporters who produce high cineol oils from more suitable species such as E. polybracteata which also produce higher total oil yields per ton of leaves. A recent interesting development in pharmacy has indicated the importance of rutin, a water-soluble pigment which is of value in treating capillary fragility. The present commercial source of this substance is the foliage of Sophora japonica, but recent studies have shown that Eucalyptus macrorhyncha may be equally suitable. Although this species has been grown in Southern California, few trees are now extant, and this source of rutin is not being exploited at present in the United States. Experiments in the culture of E. macrorhyncha are being conducted by N. T. Mirov of the Institute of Forest Genetics, California Forest and Range Experiment Station.

Major problems which Eucalyptus culture may help to solve.

One of the factors which furnished the main incentive for the extensive planting of Eucalyptus in California is still operative. This is the almost complete absence of a hardwood lumber producing industry. Although substitutes for hardwood have become increasingly important in house construction, furniture and farm equipment manufacture, California's continued increase in population has given rise to a large local demand for hardwood products. Most of this demand is satisfied by imports, while a slowly increasing proportion of it is met by indigenous Pacific Coast hardwoods,

notably California black oak for flooring and red alder for furniture. Much of this development results from recent improvements in seasoning practices. More of California's native hardwood species can be expected to contribute high-grade lumber in the future, as the present program of research and extension in kiln-drying techniques continues.

With this background, it is difficult to predict the future role of Eucalyptus as a lumber producer in California. None of the species at present growing in California promise to be an important source of high quality lumber. Several species not now found in California or present in small numbers have been suggested by those familiar with Australian conditions as suitable. The problem of E. regnans has already been mentioned, and should be studied further. The principal requirement, other than high timber quality and easy seasoning, of any species to be tried would seem to be its ability to thrive in that portion of California north of San Francisco, particularly in the coastal region. Here the competition with other land uses, although by no means negligible, will probably remain less intense than in other parts of the state.

The possibility that Eucalyptus may become an increasingly important source of wood pulp should not be dismissed. In California, such a development is contingent not only on the finding of hardy and otherwise suitable Eucalyptus species but on the chronic problem of industrial water supply and the competition of inexpensive and suitable conifer mill and woods waste.

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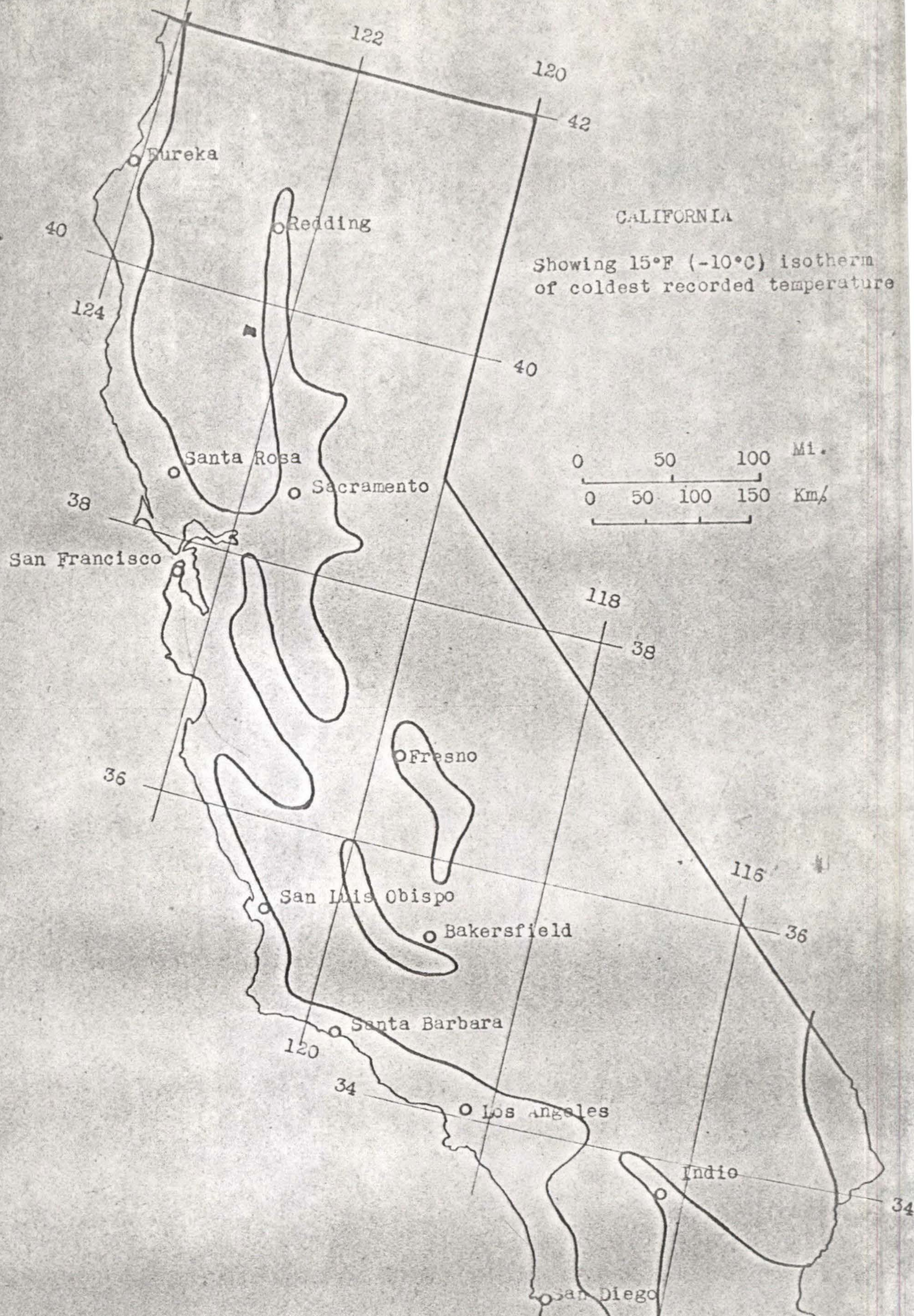
10)

APPENDIX


CALIFORNIA
Showing 15°F (-10°C) isotherm of coldest recorded temperature
0 50 100 Mi.
0 50 100 150 Km.
Eureka
Redding
Santa Rosa
Sacramento
San Francisco
Fresno
San Luis Obispo
Bakersfield
Santa Barbara
Los Angeles
Indio
San Diego
122
120
42
40
124
38
118
36
116
34

Mean Monthly and Annual Maxima °F
Mean Monthly and Annual Minima °F

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	Ann.
Eureka	53	53	54	56	57	59	60	60	61	60	58	54	57
	41	42	42	44	47	50	52	52	50	48	45	42	46
Santa Rosa	56	61	65	69	73	80	82	82	81	76	67	58	71
	36	38	39	41	43	47	49	47	46	43	38	35	42
Redding	54	59	64	71	79	88	96	95	87	77	64	55	74
	37	40	43	48	54	61	67	65	59	52	44	38	51
Sacramento	52	58	63	69	75	84	89	88	84	75	64	53	71
	39	43	46	48	52	56	58	57	56	50	44	39	49
Bakersfield	58	66	70	76	83	94	100	99	91	82	71	60	79
	36	39	42	47	53	59	64	62	56	48	41	35	49
Fresno	54	61	66	74	81	91	99	97	89	78	66	55	76
	38	42	44	48	53	59	65	63	58	51	43	38	50
San Francisco	55	58	60	62	63	65	65	65	68	68	63	56	62
	45	47	48	49	50	52	53	53	55	54	51	46	50
San Luis Obispo	62	64	65	67	68	74	77	77	77	75	71	64	70
	42	44	45	46	47	50	52	52	52	49	45	42	47
Santa Barbara	64	65	66	68	69	72	76	77	76	74	72	67	71
	43	44	46	48	50	53	56	57	55	51	46	43	50
Indio	70	75	80	86	93	102	106	106	101	91	80	71	88
	39	44	50	57	63	72	78	76	69	58	46	39	58
Los Angeles	65	65	67	69	72	76	81	82	81	76	72	67	73
	46	47	48	50	53	56	60	60	58	54	50	47	53
San Diego	62	63	64	65	66	69	72	74	73	70	68	64	68
	47	48	50	52	56	59	62	64	61	57	52	48	55

Mean Monthly and Annual Precipitation - Inches

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	Ann.
Eureka	6.98	6.30	5.13	3.35	1.73	.73	.11	.17	.98	2.27	5.04	6.25	39.04
Santa Rosa	6.32	5.23	4.03	1.83	1.25	.26	.05	.02	.52	1.53	3.38	5.44	29.86
Redding	7.26	6.04	4.92	2.81	1.86	.76	.10	.06	.82	2.16	4.28	6.25	37.42
Sacramento	3.80	2.83	2.75	1.46	.75	.12	.02	.01	.26	.78	1.93	3.79	18.50
Bakersfield	1.04	.87	1.00	.49	.40	.05	.02	.01	.13	.35	.51	.75	5.62
Fresno	1.69	1.41	1.57	.92	.42	.08	.01	.01	.21	.54	.92	1.41	9.19
San Francisco	4.70	3.65	3.09	1.52	.69	.15	.01	.02	.31	.96	2.51	4.40	22.01
San Luis Obispo	4.87	3.98	3.46	1.44	.56	.09	T	.02	.25	.88	1.73	3.64	20.92
Santa Barbara	4.13	3.61	2.91	1.16	.46	.08	.02	.02	.38	.75	1.45	3.07	18.04
Indio	.75	.45	.29	.11	.05	.01	.05	.22	.21	.18	.18	.50	3.00
Los Angeles	3.06	2.97	2.78	1.03	.45	.07	.01	.03	.16	.65	1.18	2.56	14.95
San Diego	1.84	1.90	1.50	.67	.34	.06	.05	.09	.09	.41	.88	1.84	9.67

Mean Monthly and Annual Maxima °C
Mean Monthly and Annual Minima °C

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	Ann.
Eureka	12	12	12	13	14	15	16	16	16	16	14	12	14
	5	6	6	7	8	10	11	11	10	9	7	6	8
Santa Rosa	13	16	18	21	23	27	28	28	27	24	19	14	22
	2	3	4	5	6	8	9	8	8	6	3	2	6
Redding	12	15	18	22	26	31	36	35	31	25	18	13	23
	3	4	6	9	12	16	19	18	15	11	7	3	11
Sacramento	11	14	17	21	24	29	32	31	29	24	18	12	22
	4	6	8	9	11	13	14	14	13	10	7	4	9
Bakersfield	14	19	21	24	28	34	38	37	33	28	22	16	26
	2	4	6	8	12	15	18	17	13	9	5	2	9
Fresno	12	16	19	23	27	33	37	36	32	26	19	13	24
	3	6	7	9	12	15	18	17	14	11	6	3	10
San Francisco	13	14	16	17	17	18	18	18	20	20	17	13	17
	7	8	9	9	10	11	12	12	13	12	11	8	10
San Luis Obispo	17	18	18	19	20	23	25	25	25	24	22	18	21
	6	7	7	8	8	10	11	11	11	9	7	6	8
Santa Barbara	18	18	19	20	21	22	24	25	24	23	22	19	22
	6	7	8	9	10	12	13	14	13	11	8	6	10
Indio	21	24	27	30	34	39	41	41	38	33	27	22	31
	4	7	10	14	17	22	26	24	21	14	8	4	14
Los Angeles	18	18	19	21	22	24	27	28	27	24	22	19	23
	8	8	9	10	12	13	16	16	14	12	10	8	12
San Diego	17	17	18	18	19	21	22	23	23	21	20	18	20
	8	9	10	11	13	15	17	18	16	14	11	9	13

Mean Monthly and Annual Precipitation - mm.

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	Ann.
Eureka	178	160	130	85	44	19	3	4	25	58	128	159	982
Santa Rosa	161	133	102	46	32	7	1	1	13	39	86	138	759
Redding	185	153	125	71	47	19	3	2	21	54	109	159	948
Sacramento	97	72	70	37	19	3	1	T	7	20	49	97	470
Bakersfield	26	22	25	12	10	1	1	T	3	9	13	19	143
Fresno	43	36	40	23	11	2	T	T	5	14	23	36	234
San Francisco	119	93	79	39	18	4	T	1	8	24	64	112	560
San Luis Obispo	124	101	88	37	14	2	T	1	6	22	44	93	531
Santa Barbara	105	92	74	29	12	2	1	1	10	19	57	78	458
Indio	19	11	7	3	1	T	1	6	5	5	5	13	76
Los Angeles	78	75	71	26	11	2	T	1	4	17	30	65	380
San Diego	47	48	38	17	9	2	1	2	2	10	22	47	246

Length of Growing Season
Last Killing frost to first killing frost - days

Eureka	277	San Francisco	350
Santa Rosa	204	San Luis Obispo	316
Redding	274	Santa Barbara	335
Sacramento	305	Indio	302
Bakersfield	274	Los Angeles	359
Fresno	289	San Diego	365

Relative frost hardiness of Eucalyptus species in Southern California from Munns (7)

Very resistant to low temperatures

E. viminalis
E. polyanthema
E. gunni
E. regnans
E. crebra

Resistant to low temperatures

E. tereticornis
E. rostrata
E. globulus
E. coriacea
E. resinifera
E. corynocalyx xx
E. robusta
E. goniocalyx

xx was frozen out at Arroyo Grande but there are good trees at Patterson Ranch, outer Alameda Co.

this grove was cut 1956.

Frost sensitive but capable of recovering from injury

? E. sideroxylon
E. stuartiana
E. citriodora
E. longifolia
E. amygdalina
E. saligna

Very frost sensitive

? E. rudis.
E. corymbosa
E. leucoxylon
E. cornuta
E. calophylla
E. diversicolor

would put these higher than they are here

Metcalf

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Only a few years ago there were about 200,000 eucalyptus trees in Abkhazia. By the beginning of 1949, this number had increased 25 times; this year it is planned to plant about 7,000,000 eucalyptus trees in Abkhazia. A large part of this plan already has been carried out. The Central Committee of the Georgian Communist Party has adopted a resolution to import up to 100,000,000 eucalyptus seedlings into the republic by the end of 1955. Eleven state shelter belts of eucalyptus plantings, totalling 700 kilometers in length, will be laid down in western Georgia.........

<u>EUCALYPTUS NURSERY IN GEORGIA.</u> (Pravda, Aug. 19 pl, 75 words.

Summary:) Tbilisi (Tiflis) - A 55 - Hectare state nursery is being laid out near the city of Zestafoni. During 1950-1954 the nursery will grow about 4,000,000 eucalyptus and 3,000,000 conifer Seedlings.

COPY

EUCALYPTUS. (By N. Zhdanov, Izvestia, Aug. 18, p2., 1,250 words
Condensed text:) Abkhazie -

Australia is the geographic homeland of the eucalyptus. But when the scientist of the future writes about his research on eucalyptus forests in the southern part of the Soviet Union (such forests will soon be in existence), he will have to admit that the real homeland of the eucalyptus is Soviet Abkhazia. In very fact, this tree, which has made its appearance comparatively recently, is taking root here with astounding rapidity......

Intensified planting of eucalyptus trees is under way along the entire Black Sea coast as well as in other southern districts of our country. Unfortunately, the eucalyptus is not frost-resistant. For the time being this is making it difficult to plant eucalyptus trees in more northern districts. However, we can be sure that our mightly Michurinite biology will acclimatize these remarkable trees to more severe weather and will move them north. This year eucalyptus and citrus trees have been planted on a large scale in the Crimea, Krasnoyarsk Territory Azerbaidzhan and other southern districts.

The nature of eucalypti is now being carefully studied. The selection Station of Humid-Tropical Crops, near Sukhumi, is especially active--- The Director of the Station is Archel Gogiberidze, sunburned and full of inexhaustible energy. Last year he was with a scientific mission in Florida, where he studied condition under which citrus fruits ripen. He returned with the deep conviction that "our Soviet sun is better than the American sun and our eucalyptus and citrus trees have a greater future".... The selection station has tested about 50 new hybrid eucalyptus trees and has already recommended production of a commercial assortment of 17 of the more valuable and frost-resistant types of eucalyptus/....

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This report was prepared for forwarding to the Food and Agriculture Organization of the United Nations as a preliminary to the FAO - sponsored _Eucalyptus_ Study Tour of Australia in September-October 1952.

No field work was done by the writer in the preparation of this report, which had to be completed in two weeks, in addition to the writer's regular work. Much of the information and some of the points-of-view were obtained from conversations with Professor Woodbridge Metcalf, whose help is gratefully acknowledged. A thesis by Miss Jacqueline Lanson (cited in the bibliography) furnished an insight into the history, present distribution and voluminous literature, and was of material help in organizing the present report.

California readers will no doubt be annoyed to find Metcalf's yield table converted to metric units. If so, they are referred to the original.

JW Duffield